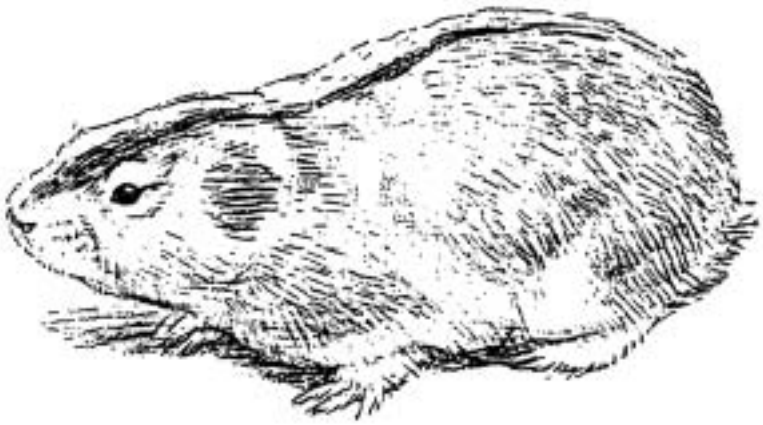
Mammal Inventory of Alaska's National Parks and Preserves

Northwest Network: Western Arctic Parklands

Bering Land Bridge National Preserve
Cape Krusenstern National Monument
Kobuk Valley National Park
Noatak National Preserve

Annual Report 2001



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Executive Summary

This project was a cooperative effort of the University of Alaska Museum (UAM), the Inventory and Monitoring Program of the National Park Service (NPS) of Alaska, and the Beringian Coevolution Project at Idaho State University. Also participating in this project were scientists from the U.S. National Parasite Collection-Beltsville, Maryland, the University of New Mexico, the Harvard School of Public Health, Institute of Biological Problems of the North-Magadan, Russia, Vantaa Research Centre-Vantaa, Finland, and the University of Saskatchewan-Saskatoon, Canada.

This report details the inventory of the mammals at 17 general localities in the Western Arctic Parklands (the Parklands) of the National Park Service of Alaska, which includes the Bering Land Bridge National Preserve (BELA), Cape Krusenstern National Monument (CAKR), Kobuk Valley National Park (KOVA), and Noatak National Preserve (NOAT) in July and August, 2000 and 2001. We begin the process of documenting the approximately 35 species of land mammals that occur in the Parklands, with a primary focus on small mammals (the shrews, voles, lemmings, weasels, porcupine, squirrels, and hares)

This survey of the Parklands (322 person days and over 16,000 trap nights of sampling effort) resulted in 1027 primary specimens which documented 15 small mammal species.

This inventory included a rigorous protocol for the physical documentation of the data including the systematic collection of diverse preparations of museum specimens. In addition to standard mammal preparations (fluid preserved, skin, and skeletal preparations), we archived ultrafrozen tissues (heart, liver, kidney, lung, spleen) for future toxicology, genetic or stable isotope research. We also preserved a significant series of ectoparasites (e.g., fleas, ticks, lice), endoparasites (e.g., helminth worms), blood borne parasite preparations (e.g., babesia), and other protozoan preparations (e.g., coccidian) or viral (e.g., hantavirus) preparations. Much of this material is currently under investigation by a number of laboratories worldwide and will result in a more holistic view of the mammalian diversity in the Western Arctic Parklands and of the area's historical importance as a center of diversification and dispersal.

Perspectives on the value of the specimen-based approach to inventory and monitoring are discussed, and recommendations for future efforts are enumerated.

*One of the highlights from the field work was the documenting of the tiny shrew (*Sorex yukonicus*) in the Bering Land Bridge National Preserve. These records contribute to the few known to science and extend the known distribution of this newly described species significantly. Their discovery based on the field work and specimens suggest that significant new information will be forthcoming regarding our understanding of the mammalian fauna of the Western Arctic Parklands.*

Introduction

This report details an inventory of the small mammals of the Western Arctic Parklands (Parklands), which comprises the Bering Land Bridge National Preserve (BELA), Cape Krusenstern National Monument (CAKR), Kobuk Valley National Park (KOVA), and the Noatak National Preserve (NOAT), in July and August of 2000 and 2001. The University of Alaska Museum and the Beringian Coevolution Project at Idaho State University (ISU) worked collaboratively with the Inventory and Monitoring Program of the National Park Service, Alaska to conduct an inventory at selected sites throughout the Parklands to document the occurrence, relative abundance, and general habitat affinities of the small mammal fauna. This effort provided a large series and variety of permanently preserved materials and associated data sets for taxonomic, zoogeographic, ecological, genetic, parasitological, epidemiological, and other research and management purposes.

The documentation of species' occurrence in the Parklands was complemented by a review of specimen holdings at the University of Alaska Museum (UAM) and other major collections, primarily the U.S. National Museum (USNM).

Scientific and common names of mammals used in this report follow Wilson and Reeder (1993) and Wilson and Cole (2000), respectively. Vegetation classification generally follows Viereck et al. (1992).

Methods and Materials

In July and August of 2000 and 2001, UAM field crews sampled 17 base locations (Table 1) for a total of 322 person-days (over 16,000 trap nights of collecting effort). The sites were scattered throughout the Parklands (Figures 1, 2) in a variety of tundra and taiga habitats. Logistical support was provided by the National Park Service.

Field Locations

BERING LAND BRIDGE

Devil Mountain Lakes (66°23'N, 164°29'W; 16 m elevation). 24 - 27 July 2001. Thirty-three animals, comprising 7 species (including 3 *Sorex yukonicus* and 1 *Ondatra zibethicus*) were sampled in a variety of herbaceous and scrub habitats.

Kuzitrin Lake (65°23'N, 163°'16W; 430-460 m elevations). 27 - 31 July 2001. At this location, we sampled 22 small mammals, comprising 5 species, in low scrub and graminoid vegetation types.

Serpentine Hot Springs (65°51'N, 164°42'W). 3 – 11 August 2001. During 8 days at this location, 129 small mammals of 8 species were collected, including 1 *Sorex yukonicus*.

CAPE KRUSENSTERN

Rabbit Creek (67°31'N, 163°35'W). 14 - 18 July 2001. A variety of scrub and herbaceous habitats were sampled, resulting in the capture of 16 small mammals representing 6 species.

Red Dog Road (67°37'N, 163°51'W; 67°44'N, 163°36'W). 18 - 21 July 2001. Two areas sampled along the Red Dog Road resulted in the capture of 11 animals of 5 species in 2001.

Situkuyok River (67°12'N, 163°10'W). 10 – 14 July 2001. Our samples from this site on the west bank of the Situkuyok River totaled 14 individuals of 6 species.

Tukrok River (67°04'N, 163°19'W). 25 – 28 July 2000. Several herbaceous and scrub sites were sampled here in 2000, resulting in the capture of 45 individuals of 4 species.

KOBUK VALLEY NATIONAL PARK

Kallarichuk River (67°05'N, 159°47'W). 4 – 8 August 2001. A number of traplines in needleleaf forest and tall scrub habitats were established near the confluence of the Kallarichuk and Kobuk rivers, resulting in the capture of 64 animals of 4 species, including *Microtus xanthognathus*.

Kavet Creek (67°07'N, 159°02'W). 5 – 9 August 2000. Five traplines were established in early August 2000 in a number of forest and herbaceous habitats near the confluence of Kavet Creek and the Kobuk River and at the NE edge of the Great Kobuk Sand Dunes. This effort resulted in the capture of 146 small mammals of 4 species.

Onion Portage (67°06'N, 158°16'W). 8 – 12 August 2001. A variety of forest, woodland and scrub habitats were sampled here, resulting in the capture of 65 animals comprised of 6 species.

NOATAK NATIONAL PRESERVE

Aniralik Lake (68°12'N, 159°49'W; 227-240 m elevations). 31 July – 4 August 2001. A number of herbaceous and scrub sites were sample in the vicinity of Aniralik Lake, resulting in the capture of 92 small mammals of 5 species.

Asik Mountain (67°28'N, 162°13'W). 27 – 30 July 2001. Base camp was located approximately 5 km E of Asik Mountain. A mixed woodland and a number of herbaceous sites were sampled, resulting in the capture of 66 small mammals of 7 species.

Copter Peak (68°28'N, 161°28'W; 460 m elevation). 24 – 27 July 2001. Base camp was located about 8 km W of Copter Peak in a variety of herbaceous and scrub habitats. A total of 40 animals of 3 species were sampled.

Desperation Lake (68°20'N, 158°44'W; 400 m elevation). 10 – 14 July 2001. Traplines were established in a variety of herbaceous habitats in the vicinity of Desperation Lake with 8 animals of 3 species captured here.

Kaluich Creek (67°39'N, 158°11'W; 460 m elevation). 18 - 22 July 2001. Several upland herbaceous habitats were sampled near this tributary of Cutter River. A total of 57 small mammals of 5 species were collected.

Kelly River (67°55'N, 162°17'W). 31 July – 3 August 2000. A total of 148 small mammals of 3 species were sampled in open needleleaf forest habitat at several km NE of the confluence of the Kelly and Noatak rivers in 2000.

Sidik Lake (68°08'N, 158°59'W; 290-300 m elevations). 14 – 18 July 2001. Traplines set in a number of herbaceous habitats in the vicinity of Sidik Lake resulted in the capture of 67 small mammals of 5 species.

Field Studies

Two field crews sampled the Parklands in 2000 and 2001. In 2000, these crews consisted of Amy Runck, John Bender, and Richard Runck. In 2001, one crew included Amy Runck, Nickolai Dokuchaev, Robert Foster, Erick Tomasik, Kerynn Fisher; the second crew included Vadim Fedorov, Alexei Fedorov, Eric Waltari, and Brent Wagner.

Our collecting strategy was designed to maximize the number and diversity of samples by using a variety of methods in available habitats. While particular effort was made to sample rare or undocumented small mammals, the sampling methods used also allowed us to evaluate the occurrence and relative abundance of the more common species.

Diversity of captured specimens was maximized by utilizing a variety of trap types, including snap traps (Museum Specials, rat traps) and live traps (44 oz. plastic drinking cups buried as pitfall traps, Sherman live traps). Larger species, such as the arctic ground squirrel, were sampled with shotgun.

Traplines for shrews and voles were set in the range of available habitats and ecotones in each study location. Traplines typically consisted of 20 or more trap stations per line, with stations spaced 8-10 m apart. At each station, 2 snap traps or 1 snap trap and 1 pitfall trap were typically set within 2 m of each station point. The snap traps were baited with a mixture of rolled oats and peanut butter; pitfall traps were buried flush with the ground and left unbaited. Traps were usually set in the late afternoon and checked the following morning. Productive lines were usually kept in operation for 2 or more nights.

Specimen Processing

Each animal sampled was preserved as a scientific specimen in the form of a skeletal preparation or as a whole bodied fluid (ETOH) preparation. A small number of dried study skins were also prepared. Each crew carried tank of liquid nitrogen in the field to preserve tissues (heart, liver, kidney, spleen, and lung) and embryos. These frozen specimens were transferred to ultra-low temperature freezers at UAM and are archived at -70° C. We preserved ectoparasites, endoparasites and feces samples from many of the mammals collected. These exceptional data sets will be used to address epidemiological, coevolutionary, taxonomic, and biogeographic questions. Intestinal tracts from shrews were also preserved. Field protocols (Appendix) allowed us to rigorously document and preserve specimens.

All mammal specimens from this study have been accessioned into the mammal collection at UAM and are in process of curation and data entry and transfer. The samples of endoparasite are now at the US National Parasite Collection in Beltsville, MD, and ectoparasites are at Idaho State University. Feces samples (for Coccidia) are already under study at the University of New Mexico, and lung samples (for Hanta virus) are being examined by colleagues in Finland.

Results and Discussion

Inventory Results

The specific products of this inventory include a large collection of well-prepared, well-documented, and diverse preparations of mammal specimens and associated materials (tissues, parasites, fecal samples, digestive tracts). A total of 1027 small mammal specimens (excluding embryos) comprising 15 species was archived from 17 general collecting localities in the Parklands in July and August, 2000 and 2001 (Table 1).

The red-backed vole and the tundra vole were the most frequently captured species (415 and 208 specimens, respectively), comprising over 60% of all specimens collected (Figure 3). Thirteen additional species, in descending order of overall specimen abundance, were cinereus

shrew, singing vole, taiga vole, arctic ground squirrel, tundra shrew, brown lemming, barren ground shrew, collared lemming, montane shrew, tiny shrew, red squirrel, muskrat, and porcupine. The number of small mammals sampled in each of the Parkland units is shown in Figures 4-7.

This study, when combined with specimen information gathered from our review of holdings in other major collections, increased the total number of documented small mammal species in each Parkland:

BELA—15 of 16 probable species (Table 2), or 93% coverage.
CAKR—11 of 14 species (Table 3), or 79% coverage.
KOVA—10 of potential 17 species (Table 4), or 59% coverage.
NOAT—16 of 17 species (Table 5), or 94% coverage.

The discovery of tiny shrews (*Sorex yukonicus*) constitutes a new species for BELA and the Seward Peninsula and is a major range extension of this species. The barren ground shrew (*Sorex ugyunak*) is also a new mammal for BELA and its capture there is a significant range extension. This shrew was also added to the faunal list of CAKR and NOAT. This study also extended the range of the montane shrew (*Sorex monticolus*) westward into CAKR, and the taiga vole (*Microtus xanthognathus*) westward from the upper Kobuk River valley into KOVA.

Species Accounts

The following accounts summarize information on each species known or suspected to occur in the Western Arctic Parklands. The abbreviated name of Parkland units where the animal was documented in this study is listed in parentheses following its scientific and common name. An asterisk (*) indicates that species were observed but not collected in this study or that the species has been previously documented from other investigations. Species that have been reported or may occur in the Parklands, but have not been adequately documented are marked with a dagger (†). Detailed data on all specimens will soon be available in the UAM database and accessible on its website (http://arctos.museum.uaf.edu:8080/uam_db/) once the time consuming process of curation is completed sometime in early 2002.

Order **INSECTIVORA**—Shrews

Family **Soricidae**

Sorex cinereus, cinereus shrew (BELA, CAKR, KOVA, NOAT)

We captured more cinereus shrews than any other species of shrew (Figure 3). We sampled this species at 7 of 17 general localities (Table 1), with the largest series of specimens from Serpentine Hot Springs in BELA on the Seward Peninsula (Figure 4). Cinereus shrews occurred in all major vegetation types (Table 6), but were relatively most abundant in scrub and open forest habitats (Figure 8). Pitfall traps accounted for most shrew captures. The cinereus shrew is the dominant shrew in many communities throughout its range in Alaska. Their abundance and ecological flexibility may be responsible, at least partially, for the general scarcity of other shrew species (Wrigley et al. 1979).

† *Sorex hoyi*, pygmy shrew

No pygmy shrews were collected in this study. This generally uncommon species has been found scattered throughout central Alaska, with the closest record coming from a forested site in the upper Kobuk River valley in the Kobuk Preserve Unit of Gates of the Arctic National Park and Preserve (Swanson 1996; UAM).

Sorex monticolus, montane shrew (BELA, CAKR)

This species was found only at Serpentine Hot Springs (2 samples) and at Situkuyok River (3 samples). The species has been documented in all Parkland units (Tables 2-5) and is at the northwestern edge of its range. Gardner (1974) reported the capture of montane shrews in the Noatak River Valley from under willows in well-drained situations close to rivers and lakes.

Sorex tundrensis, tundra shrew (BELA, CAKR, KOVA, NOAT)

Small numbers of tundra shrews were sampled at 9 localities in all 4 Parklands units (Table 1). They were found in a diversity of vegetation types (Table 6) but were most abundant in open forest and woodland communities (Figures 8, 10).

Sorex ugyunak, barren ground shrew (BELA, CAKR, NOAT)

The taxonomy and distribution of *Sorex ugyunak* have been problematic. The barren ground shrew was formerly included as a subspecies of *Sorex cinereus* (e.g., Hall 1981), but van Zyll de Jong (1976, 1991) provided arguments for considering *ugyunak* distinct from *cinereus*.

Dr. N. Dokuchaev, a shrew expert from the Institute of Biological Problems of the North, Magadan, Russia, and participant of this study, confirmed the identities of 6 *ugyunak* sampled in 3 of the 4 Parkland units (Table 1). None was collected in KOVA; however, Dr. Dokuchaev has confirmed the occurrence of *ugyunak* in the Kobuk River Valley from a UAM specimen that was taken just east of KOVA near Ambler. The occurrence of this shrew in BELA (along with several other UAM records from elsewhere on the Seward Peninsula) is a significant range extension. The preference of this high Arctic species for moist-to-wet sedge-grass tundra and thickets of willow and dwarf birch (Bee and Hall 1956, Van Zyll de Jong 1999) is consistent our limited findings (Table 6, Figure 8).

Sorex yukonicus, tiny shrew (BELA)

The tiny shrew is a new species to BELA, the Parklands, and the Seward Peninsula. These captures constitute a major range extension. Prior to this inventory, only 12 specimens of *S. yukonicus* were known to science (Dokuchaev 1997; pers. com. 2001). All are from Alaska, with the closest record from Galena, the type locality of the species.

Despite considerable effort, only 4 tiny shrews were captured in pitfall traps. Three of the 4 were taken in low scrub vegetation near Devil Mountain Lakes; the other was captured in similar habitat near Serpentine Hot Springs.

Order **CARNIVORA**—Carnivores

Family **Canidae**

***** *Alopex lagopus*, arctic fox

An arctic fox was seen at Kuzitrin Lake (BELA). This species occurs along the arctic coast of Alaska as far south as the northwestern shore of Bristol Bay, with individuals occasionally found considerable distances inland (Manville and Young 1965, Chesemore 1968, ADFG 1978, Bailey 1993).

† *Canis latrans*, coyote

Coyotes or their sign were not observed or reported. The only preserved specimen from this region is in the USNM from Kotzebue taken in 1938. Gardner (1974) claimed to have seen tracks of this species in the Noatak River Valley. Coyotes are said to have arrived as newcomers to Alaska sometime around the early 1920s (Rearden 1981) and reaching peak numbers about 1940 (Dufresne 1946).

* *Canis lupus*, wolf
Wolf sign was reported by our crews in BELA, KOVA and NOAT.

* *Vulpes vulpes*, red fox
Red fox were noted at Asik Mountain, Kallarichuk River, Situkuyok River, Red Dog Mine Road, and Kuzitrin Lake.

Family **Felidae**
† *Lynx canadensis*, Canada lynx
Lynxes were not seen during this study, and no specimens are known. ADFG (1978) considered the forests of the lower Noatak and Kobuk River systems prime habitat for this species

Family **Mustelidae**
* *Gulo gulo*, wolverine
A lone wolverine was seen near the Kobuk River in transit between Kallarichuk River and Onion Portage.

† *Lontra canadensis*, northern river otter
River otters or their sign was not observed or reported during our time in the study area, and no specimens are known. This species is apparently found in the lower and middle Noatak River and the upper Kobuk River (ADFG 1978).

† *Martes americana*, American marten
Martens probably do not occur in any of NW Parkland units, although they may inhabit the eastern portion of the Seward Peninsula and the upper Kobuk and Noatak drainages (ADFG 1978).

* *Mustela erminea*, ermine
Ermines were not seen or reported, but specimens from BELA and NOAT have been preserved in museum collections.

* *Mustela nivalis*, least weasel
Least weasels were not collected or observed. Specimens have been preserved from BELA and NOAT. The species is generally uncommon and sparsely distributed throughout much of its holarctic range. It occupies a wide variety of forest and tundra habitats, but favors meadows, marshes, and riparian situations where small rodent prey are found in abundance (Banfield 1974).

* *Mustela vison*, American mink
No sightings or sign of this species were noted. Very limited numbers probably occur in all 4 NW Parkland units, but especially in the Noatak and Kobuk rivers drainages (Dean and Chesemore 1974, Gardner 1974). Mink have been documented with specimens in all units except CAKR.

Family **Ursidae**
***Ursus americanus*, American black bear
Black bears were not seen or reported. They are known to occur in the Kobuk drainage (Dean and Chesemore 1974), although this has not been adequately documented.

*****_Ursus arctos_, brown bear

Brown bears or their sign were reported from Desperation Lake, Copter Peak, Asik Mountain, Serpentine Hot Springs, Kallarichuk River, and Onion Portage. Specimens have been preserved from BELA and NOAT.

Order **ARTIODACTYLA**—Ungulates

Family **Cervidae**

*****_Alces alces_, moose

Our field crews reported moose and/or their sign at Sidik Lake, Asik Mountain, Kallarichuk River, Situkuyok River, and Onion Portage.

*****_Rangifer tarandus_, caribou

Caribou sign was seen at Desperation Lake, Copter Peak, Aniralik Lake, Kallarichuk River, Situkuyok River, Kuzitrin Lake, Serpentine Hot Springs, and Onion Portage.

Family **Bovidae**

† _Ovibos moschatus_, muskox

Muskoxen were noted at Situkuyok River. Muskoxen were transplanted to Cape Thompson on the northwest Arctic coast and on the Seward Peninsula in 1970 (Burris and McKnight 1973). By 1990, the northwestern population was estimated at 130 animals, and 700 on the Seward Peninsula (Smith 1994). The current status and distribution of muskoxen in the Western Arctic Parklands is in need of clarification.

† _Ovis dalli_, Dall's sheep

Dall's sheep were not noted during this study. They apparently have an erratic distributional pattern in the Baird and Schwatka mountains (Dean and Chesemore 1974), with sightings reported from the headwaters of the Eli River, between the Cutler and Ambler rivers, and near Howard Pass (Gardner 1974, Dean and Chesemore 1974). Dean and Chesemore (1974) noted that sheep are rare in the Baird Mountains east of the Salmon River.

Order **RODENTIA**—Rodents

Family **Sciuridae**

† _Marmota broweri_, Alaska marmot

Marmots were not seen by us but hikers met at Copter Peak said they had seen marmot sign nearby. No specimens are known from the Parklands. Dean and Chesemore (1974) reported marmot sign in the northern Baird Mountains near the Nakolik River, and Gardner (1974) sighted a marmot in the vicinity of Mulik Hills on the lower Noatak.

Spermophilus parryii, arctic ground squirrel (BELA, CAKR, KOVA, NOAT)

Arctic ground squirrels were sampled at 8 localities and in all NW Parkland units.

Tamiasciurus hudsonicus, red squirrel (KOVA)

Red squirrels were sampled in spruce forest at Kallarichuk River and Onion Portage. The species is not known to occur in any other NW Parkland unit.

Family **Castoridae**

† *Castor canadensis,* American beaver

Beavers were not seen or reported, and no specimens are known. Neither Gardner (1974) nor Dean and Chesemore (1974) mentioned beavers in either KOVA or NOAT. ADFG (1978), however, stated that beavers had recently colonized the Kobuk Valley, particularly in the lower portion of the drainage, and that they occasionally occurred in the upper Koyuk drainage of the Seward Peninsula. If so, they possibly occur in BELA.

Family **Muridae**

Clethrionomys rutilus, northern red-backed vole (BELA, CAKR, KOVA, NOAT)

Red-backed voles were the most frequently captured small mammal species, occurring at 15 of 17 localities sampled (Table 1).

Dicrostonyx groenlandicus, collared lemming (BELA, CAKR, NOAT)

Six collared lemmings were sampled in this study. None was collected in KOVA, and no specimens are known from this Park, although this arctic species likely occurs there.

Lemmus trimucronatus, brown lemming (BELA, CAKR, KOVA, NOAT)

We sampled a total of 18 brown lemmings at 6 localities (Table 1). Most were associated with mesic and wet herbaceous habitats.

Microtus miurus, singing vole (BELA, CAKR, NOAT)

A total of 101 singing voles from 7 localities were sampled in this study. The species is documented in all NW Parkland units except KOVA.

Microtus oeconomus, tundra vole (BELA, CAKR, KOVA, NOAT)

Tundra voles were found at 15 of the 17 localities surveyed and were the second-most common mammal sampled.

Microtus xanthognathus, taiga vole (KOVA)

Taiga voles are a semi-colonial species of open forest and scrub that we found only in the middle Kobuk Valley at Kallarichuk River and Kavet Creek. These localities are at the extreme northwesternmost limit of their known range (Conroy and Cook 1999).

Ondatra zibethicus, muskrat (BELA)

A single muskrat was collected in Devil Mount Lakes in 2001. This species has been documented in CAKR (Kilikmak Creek, UAM) and NOAT (USNM, Gardner 1974). No specimen is known specifically from KOVA, although apparently they were abundant in the lower Kobuk Valley, but less so upriver (Dean and Chesemore 1974).

† *Synaptomys borealis,* northern bog lemming

Northern bog lemmings were not encountered during this study; however, there is a good chance that they eventually will be found in KOVA as Swanson (1996; UAM) reported them from seral spruce forest in the upper Kobuk River valley. This species is usually uncommon or rare throughout its range, but can become numerous some years.

Family **Erethizontidae**

Erethizon dorsatum, North American porcupine (KOVA, NOAT)

Porcupines are probably rare but widespread throughout the NW Parklands. A single animal was collected at Asik Mountain in NOAT. UAM also has a porcupine specimen from the Great Kobuk Sand Dunes in KOVA.

Order **LAGOMORPHA**—Pikas and Hares

Family **Leporidae**

* *Lepus americanus*, snowshoe hare

The remains of a foot believed to be of a snowshoe hare was found at Kuzitrin Lake in BELA. This specimen, now at UAM and not yet positively identified, was our only encounter with the species. Snowshoe hares have been reported in riparian and forest habitats along the Kobuk and Noatak rivers (Henshaw 1966, Dean and Chesemore 1974, Gardner 1974). UAM and USNM have hare specimens that were collected at Arviriaq on the Eli River in the Noatak drainage.

*****_Lepus othus_, Alaskan hare

The Alaskan hare is currently found in the tundra regions south of Kotzebue Sound (Klein 1995). It has been documented with specimens in BELA on the Seward Peninsula. Historically, its range may have extended northward to include areas in the northern Parklands. A Kotzebue resident had recently seen Alaskan hares in the Noatak Delta and on the lower Agashashok River (Alex Whiting, pers. com.), suggesting the possible occurrence of this Alaska endemic in NOAT and perhaps CAKR.

Habitat Affinities

Habitats of small mammals are often defined by their association with particular plants (Hoffmeister 1986). Under the influences of the topography, soils, climate conditions, and other ecological factors, plants may be placed into distinct groups referred to as vegetative communities, associations, or types. A mammal species usually is associated with particular plant communities (at various macro- to micro-scales). Some species are restricted to few communities, others are found in many. The degree of a species' dominance in a particular vegetative community and its range across various communities often is relates to varying population levels. Populations of small mammals of high latitudes often fluctuate dramatically from year to year and season to season. These shifts in abundance, along with dynamic interspecific interaction (particularly among congeneric species) suggest that long-term studies of small mammal communities will be required to carefully assess the particular affinities of each species.

Besides vegetation, other features and factors may influence a species' distribution, including topography, soil types, snow cover, availability of food or pathogens, and/or the presence of other important features such as water bodies, rocks, and ground litter. The unique biogeographic and evolutionary history of each species also influences its current distribution. Because Alaska's habitats have changed markedly since the last glaciation, the current distribution of nearly all species must be viewed within the dynamic geologic history of these high latitudes.

Our preliminary work indicates that shrews, voles and lemmings were unevenly distributed over the range of vegetation types sampled (Figure 10). Patterns of habitat occupancy indicated that red-backed voles, which may have been at low population levels in 2001, were sampled across a broad range of vegetation types (Table 6), but were relatively most abundant in forested habitats (Figure 9). The local distribution of this common species may be closely tied to the presence of overhead cover, especially woody plant cover. Tall tussocks may serve as overhead protection in non-forested habitats.

Shrew populations also appeared to be relatively low during this study. The general habitat requirements of shrews are related to invertebrate abundance and physical conditions such as temperature and moisture (Nagorsen 1996). All shrews seem to require sites with adequate ground cover. We found cinereus shrews occurring in a diversity of vegetation types, but most often in scrub and forested sites. Tundra shrews were concentrated in forested habitats, while

barren ground shrews were restricted to herbaceous- and scrub-tundra habitats. The few tiny and montane shrews captured were in scrub habitats.

The 3 species of *Microtus* displayed differing patterns of habitat occupancy (Figures 9, 10). Taiga voles were found only in open forest and riparian scrub habitats in the Kobuk Valley, while singing voles were restricted primarily to mesic-to-dry herbaceous and scrub habitats at higher elevations. Tundra voles, in contrast, occupied grassy situations across a relatively broad range of vegetation types and elevations.

Populations of brown and collared lemmings appeared to be low during the time of this study and the small number captured were confined to herbaceous and scrub-tundra habitats.

Overall, small mammals were most diverse (species richness) in scrub and herbaceous habitats and most abundant in forest habitats (Figure 11).

Summary and Significance

This inventory confirms the importance of the Western Arctic Parklands for a rich assemblage of arctic and subarctic mammals. Of the Parklands' approximately 35 species of land mammals, most have holarctic distributions or close affinities with Old World species (e.g., Rausch 1963, Hoffmann and Peterson 1967, Hoffmann et al. 1979). Some 95% of the small mammals believed to occur in the Parklands as a whole are now documented with specimens. Specimen coverage within Parkland units, however, varies from 59% (KOVA) to 94% (NOAT).

Patterns of general habitat occupancy among 15 species sampled in the Parklands were comparable to those reported in other studies of Alaska small mammal communities (e.g., Bee and Hall 1956; Mayo 1963; Pruitt 1966, 1968; Childs 1969; Dean and Chesemore 1974, Gardner 1974; Wolf and Lidicker 1980; Douglass 1984, Batzli and Henttonen 1993, Swanson 1996). Three species—an insectivore (cinereus shrew), a generalized fruit-seed-leaf feeder (northern red-backed vole), and a graminoid grazer (tundra vole)—dominated the small mammal community of the Parklands, accounting for over 70% of all trapline captures.

Our discovery in BELA of the tiny shrew, *Sorex yukonicus*, perhaps the rarest and poorest known mammal in North America, was an unanticipated surprise. The 4 tiny shrews sampled on the Seward Peninsula significantly expands the known range of the species and together with samples collected in other NPS Units in Alaska in 2001 almost tripled the number of specimens known to science.

This study also extended the geographic range of the barren ground shrew, *Sorex ugyunak* (in BELA), the montane shrew, *Sorex monticolus* (in CAKR), and the taiga vole, *Microtus xanthognathus* (in KOVA).

The Alaska marmot, *Marmota broweri*, remains undocumented from the Parklands.

The most significant and valuable product of this inventory is the large collection of well-documented and diverse preparations of scientific specimens.

Why specimens? As elucidated by Reynolds et al. (1996), voucher specimens and corresponding data assembled during field surveys of mammals are critical for accurate identification of the animals studied and for verification of the data gathered and reported as resulting from the investigation. Voucher specimens are particularly valuable for studies of the smaller species that are difficult to identify (e.g., shrews, *Microtus* voles) and often poorly known (most Alaska small mammals).

Long after the original inventory is completed, voucher specimens and their associated materials will be used for a wide array of studies such as taxonomic revisions, biogeographic and evolutionary studies, parasitology, and epidemiology.

Voucher specimens also provide critical historical baseline for assessment of change caused by natural or human perturbations. As they represent historical populations, the value of large series of specimens increases through time, particularly as the diversity of many localities is degraded. With PCR (polymerase chain reaction) and other innovations in the study of DNA, we now can examine and monitor genetic variation in populations of animals that were collected during different time periods; thus providing a more rigorous view of temporal genetic variation and population structure. For example, known contact zones between taxa can now be reanalyzed for temporal stability (but only if specimens from the contact zone were collected at regular intervals). Because of the dynamic geologic history of Alaska and the role that glaciers played in the distribution of organisms, these kinds of studies are essential to documenting and managing biodiversity. Recent concern with POPS combined with rapid technological innovation with regard to our ability to track POPS, further enhances the utility of these specimens in such crucial areas of study such as monitoring environmental quality. Given the proximity of these Parklands to major industrialized activities such as mining and nuclear dumping, the baseline these specimens provide may indeed become critical to future NPS initiatives.

Without the preservation of specimens, inventories such as this one would have extremely limited value (either short-term or long-term). Federal tax dollars used for biodiversity assessments are most efficiently spent if agencies recognize the critical need for vouchers and provide support in both field and museum budgets for their preservation and maintenance (Reynolds et al. 1996).

While the importance of museum specimens should be generally recognized and their preparation considered essential to good science, for many the question remains: Why collect so many specimens?

Some perspectives:

- Alaska mammalogy is still in the early exploration phase. For most species of Alaska mammals, many areas are poorly known and inadequately represented in systematic collections. The Western Arctic Parklands is not an exception to this poorly developed database.
- Small numbers of specimens will not adequately represent the inherent morphologic, genetic, and parasitic variation that exists within and among populations. Rigorous and statistically defensible scientific studies require large samples of well-preserved (and diverse) materials to account for age, sex, geographic, and/or individual variation. Taxonomic studies based on skull morphology may require undamaged material from 20 or more adult individuals of each sex per locality (i.e., a minimum of 40 individuals per population).
- Many of the shrews and small rodents are difficult or impossible to identify except through the careful study of specimens. Close examination of tooth pattern and comparison of body measurements and other characters are necessary to distinguish most of Alaska's shrews. Voles of the genus *Microtus* can also be especially difficult to differentiate.
- Considerably sampling effort is needed to document the rare and uncommon species. In this survey, several thousand trapnights were required to find the 4 tiny shrews amidst over 100 cinereus shrews.
- The number of animals removed from a population only has biological significance if it is related to the total number of animals in the population and their rate of replacement (Reynolds et al. 1996). Because Alaska's small mammals are short-lived and prolific, their reproductive potentials is more than sufficient to accommodate low levels of removal found in these inventory projects.

Recommendations for Future Inventory and Monitoring Efforts

1. Inventory studies must be viewed as an ongoing process. This initial inventory has set the stage for additional collaborative efforts to fully document the small mammal fauna of the Western Arctic Parklands.
    - The discovery in 2001 of the tiny shrew, *Sorex yukonicus*, in BELA (along with YUCH and WRST in eastern Alaska this same year) demonstrates just how much we have yet to learn about Alaska's small mammal fauna. Additional pitfall trapping in the Parklands and elsewhere in the state is needed to help determine the full geographic extent of this rare species' distribution, its ecological requirements, and to provide an adequate database of specimens to more precisely assess its taxonomic relationship with other Beringian shrews. Its discovery further illustrates the value of a specimen-based approach to inventory studies. Indeed, the initial detection of this new species to science was made possible only because large series of shrew specimens sampled in surveys from the 1980s were preserved and thus available for later study by specialists.
    - Marmots, presumably *Marmota broweri*, have been reported from both the DeLong and Baird mountains; however, the status and distribution of this Alaska endemic is poorly understood and in need of documentation (only about 40 specimens exist in collections).
    - The status and distribution of Alaskan hares, *Lepus othus*, throughout the Parklands needs clarification and documentation.
    - Vouchers are lacking for a number of other small mammal species that probably occur in various Parkland units, including barren ground shrew (KOVA), ermine (CAKR, KOVA), least weasel (CAKR, KOVA), collared lemming (KOVA), singing vole (KOVA), muskrat (KOVA), porcupine (BELA, CAKR, KOVA), and snowshoe hare (KOVA, and perhaps BELA and CAKR).
    - Ongoing efforts, particularly in the middle Kobuk River valley, could expand the geographic range of several Interior taiga species, including pygmy shrew, northern bog lemming, and perhaps meadow vole (*Microtus pennsylvanicus*).
    - Further inventory work is needed in the mountainous areas of KOVA, including the virtually unexplored Waring Mountains to the south.

2. The small mammals of the Western Arctic Parklands offer a unique opportunity for an array of studies that relate the dynamic glacial history of the region to the evolution and geography of its biota. The systematic relationships among Beringian shrews have been particularly problematic and are in need of further research efforts that are based on adequate series of diverse and well-preserved specimens.

3. Long-term monitoring on biotic change is best accomplished by preserving materials from populations sampled periodically over time. Specimen-based monitoring of northern small mammal populations has been ongoing in Scandinavia for many decades. Dr. Heikki Henttonen, esteemed colleague from Finland and participant in UAM's inventory effort, has been principal investigator of such studies for several decades . We encourage NPS to work closely with individuals such as Dr. Henttonen to develop a rigorous monitoring program in Northwestern Alaska.

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Cover drawing of *Dicrostonyx groenlandicus* is by the late William D. Berry.

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Table 1. Number of small mammal specimens from 17 general localities sampled in the Western Arctic Parklands, Alaska, in July-August, 2000 and 2001.

SPECIES	Bering Land Bridge			Cape Krusenstern				Kobuk Valley		
	Devil Mtn. Lakes	Kuzitrin Lake	Serpentine Hot Springs	Rabbit Creek	Red Dog Road	Situk-uyok River	Tukrok River	Kallarichuk River	Kavet Creek	Onion Portage
SHREWS										
Sorex cinereus	6		71	8			2			8
S. monticolus			2			3				
S. tundrensis			8	1		2	2			1
S. ugyunak		1		1		2				
S. yukonicus	3		1							
RODENTS										
Clethrionomys rutilus	4	2	23	1	2	4	16	33	86	21
Dicrostonyx groen. +	1		2		1	1				
Lemmus trimucronatus		2			2					2
Microtus miurus	3					2				
M. oeconomus		8	14	1	4		25	6	1	32
M. xanthognathus								24	58	
Ondatra zibethicus	1									
Spermophilus parryii	15	9	8	4	2			1		
Tamiasciurus hudsonicus								1		1
Erethizon dorsatum										
TOTAL # SPECIES	7	5	8	6	5	6	4	4	3	6

SPECIES	Noatak National Preserve						
	Aniralik Lake	Asik Mtn.	Copter Peak	Desperation Lake	Kaluich Creek	Kelly River	Sidik Lake
SHREWS							
Sorex cinereus	1	10					
S. monticolus							
S. tundrensis		3	1			1	1
S. ugyunak	1				1		
S. yukonicus							
RODENTS							
Clethrionomys rutilus	37	11			24	127	24
Dicrostonyx groen.				1			
Lemmus trimucronatus				2	9		1
Microtus miurus	33	1	29		13		20
M. oeconomus	20	31	10	5	10	20	21
M. xanthognathus							
Ondatra zibethicus							
Spermophilus parryii		9		5			
Tamiasciurus hudsonicus							
Erethizon dorsatum		1					
TOTAL # SPECIES	5	7	3	4	5	3	5

Table 2. Checklist of the mammals of *Bering Land Bridge National Preserve*, Alaska. Current status: ● = present and substantiated with vouchered specimen, ○ = present or probably present but not substantiated with a voucher specimen, and **?** = status unknown.

INSECTIVORA - Shrews
Family **Soricidae**
● *Sorex cinereus*, cinereus shrew
● *S. monticolus*, montane shrew
● *S. tundrensis*, tundra shrew
● *S. ugyunak*, barren ground shrew
● *S. yukonicus*, tiny shrew

CARNIVORA - Carnivores
Family **Canidae**
○ *Alopex lagopus*, arctic fox
○ *Canis lupus*, wolf
● *Vulpes vulpes*, red fox

Family **Felidae**
○ *Lynx canadensis*, Canada lynx

Family **Mustelidae**
● *Gulo gulo*, wolverine
○ *Lontra canadensis*, northern river otter
○ *Mustela erminea*, ermine
● *M. nivalis*, least weasel
● *M. vison*, American mink

Family **Odobenidae**
● *Odobenus rosmarus*, walrus

Family **Otariidae**
? *Callorhinus ursinus*, northern fur seal

Family **Phocidae**
● *Erignathus barbatus*, bearded seal
● *Phoca fasciata*, ribbon seal
● *P. hispida*, ringed seal
● *P. largha*, spotted seal

Family **Ursidae**
● *Ursus arctos*, brown bear
○ *U. maritimus*, polar bear

CETACEA - Whales
Family **Balaenidae**
○ *Balaena mysticetus*, bowhead

Family **Balaenopteridae**
? *Balaenoptera acutorostrata*, minke whale
? *B. physalus*, fin whale

Family **Eschrichtiidae**
? *Eschrichtius robustus*, gray whale

Family **Delphinidae**
○ *Orcinus orca*, killer whale

Family **Monodontidae**
○ *Delphinapterus leucas*, beluga
? *Monodon monoceros*, narwhal

Family **Phocoenidae**
○ *Phocoena phocoena*, harbor porpoise

ARTIODACTYLA - Ungulates
Family **Cervidae**
○ *Alces alces*, moose
○ *Rangifer tarandus*, caribou

Family **Bovidae**
○ *Ovibos moschatus*, muskox

RODENTIA - Rodents
Family **Sciuridae**
● *Spermophilus parryii*, arctic ground squirrel

Family **Muridae**
● *Clethrionomys rutilus*, northern red-backed vole
● *Dicrostonyx groenlandicus*, collared lemming
● *Lemmus trimucronatus*, brown lemming
● *Microtus miurus*, singing vole
● *M. oeconomus*, tundra vole
● *Ondatra zibethicus*, muskrat

Family **Erethizontidae**
○ *Erethizon dorsatum*, North American porcupine

LAGOMORPHA - Pikas & Hares
Family **Leporidae**
? *Lepus americanus*, snowshoe hare
● *L. othus*, Alaskan hare

Table 3. Checklist of the mammals of *Cape Krusenstern National Monument*, Alaska. Current status: ● = present and substantiated with vouchered specimen, ○ = present or probably present but not substantiated with a voucher specimen, and **?** = status unknown.

INSECTIVORA - Shrews
Family **Soricidae**
● *Sorex cinereus*, cinereus shrew
● *S. monticolus*, montane shrew
● *S. tundrensis*, tundra shrew
● *S. ugyunak*, barren ground shrew

CARNIVORA - Carnivores
Family **Canidae**
○ *Alopex lagopus*, arctic fox
● *Canis lupus*, wolf
○ *Vulpes vulpes*, red fox

Family **Felidae**
? *Lynx canadensis*, Canada lynx

Family **Mustelidae**
● *Gulo gulo*, wolverine
○ *Mustela erminea*, ermine
○ *M. nivalis*, least weasel
○ *M. vison*, American mink

Family **Odobenidae**
● *Odobenus rosmarus*, walrus

Family **Otariidae**
? *Callorhinus ursinus*, northern fur seal

Family **Phocidae**
● *Erignathus barbatus*, bearded seal
? *Phoca fasciata*, ribbon seal
● *P. hispida*, ringed seal
○ *P. largha*, spotted seal

Family **Ursidae**
○ *Ursus arctos*, brown bear
○ *U. maritimus*, polar bear

CETACEA - Whales
Family **Balaenidae**
○ *Balaena mysticetus*, bowhead

Family **Balaenopteridae**
? *Balaenoptera acutorostrata*, minke whale
? *B. physalus*, fin whale

Family **Eschrichtiidae**
? *Eschrichtius robustus*, gray whale

Family **Delphinidae**
○ *Orcinus orca*, killer whale

Family **Monodontidae**
○ *Delphinapterus leucas*, beluga
? *Monodon monoceros*, narwhal

Family **Phocoenidae**
○ *Phocoena phocoena*, harbor porpoise

ARTIODACTYLA - Ungulates
Family **Cervidae**
○ *Alces alces*, moose
● *Rangifer tarandus*, caribou

Family **Bovidae**
○ *Ovibos moschatus*, muskox

RODENTIA - Rodents
Family **Sciuridae**
? *Marmota broweri*, Alaska marmot
● *Spermophilus parryii*, arctic ground squirrel

Family **Muridae**
● *Clethrionomys rutilus*, northern red-backed vole
● *Dicrostonyx groenlandicus*, collared lemming
● *Lemmus trimucronatus*, brown lemming
● *Microtus miurus*, singing vole
● *M. oeconomus*, tundra vole
● *Ondatra zibethicus*, muskrat

Family **Erethizontidae**
○ *Erethizon dorsatum*, North American porcupine

LAGOMORPHA - Pikas & Hares
Family **Leporidae**
? *Lepus americanus*, snowshoe hare
? *L. othus*, Alaskan hare

Table 4. Checklist of the mammals of *Kobuk Valley National Park,* Alaska. Current status: ● = present and substantiated with vouchered specimen, ○ = present or probably present but not substantiated with a voucher specimen, and **?** = status unknown.

INSECTIVORA - Shrews
Family **Soricidae**
● *Sorex cinereus*, cinereus shrew
? *S. hoyi*, pygmy shrew
● *S. monticolus*, montane shrew
● *S. tundrensis*, tundra shrew
○ *S. ugyunak*, barren ground shrew

CARNIVORA - Carnivores
Family **Canidae**
? *Alopex lagopus*, arctic fox
● *Canis lupus*, wolf
○ *Vulpes vulpes*, red fox

Family **Felidae**
○ *Lynx canadensis*, Canada lynx

Family **Mustelidae**
● *Gulo gulo*, wolverine
? *Martes americana*, American marten
? *Lontra canadensis*, northern river otter
○ *Mustela erminea*, ermine
○ *M. nivalis*, least weasel
● *M. vison*, American mink

Family **Ursidae**
○ *Ursus americanus*, American black bear
○ *U. arctos*, brown bear

ARTIODACTYLA - Ungulates
Family **Cervidae**
● *Alces alces*, moose
● *Rangifer tarandus*, caribou

Family **Bovidae**
○ *Ovis dalli*, Dall's sheep

RODENTIA - Rodents
Family **Sciuridae**
? *Marmota broweri*, Alaska marmot
● *Spermophilus parryii*, arctic ground squirrel
● *Tamiasciurus hudsonicus*, red squirrel

Family **Castoridae**
○ *Castor canadensis*, American beaver

Family **Muridae**
● *Clethrionomys rutilus*, northern red-backed vole
○ *Dicrostonyx groenlandicus*, collared lemming
● *Lemmus trimucronatus*, brown lemming
○ *Microtus miurus*, singing vole
● *M. oeconomus*, tundra vole
● *M. xanthognathus*, taiga vole
○ *Ondatra zibethicus*, muskrat
? *Synaptomys borealis*, northern bog lemming

Family **Erethizontidae**
● *Erethizon dorsatum*, North American porcupine

LAGOMORPHA - Pikas & Hares
Family **Leporidae**
○ *Lepus americanus*, snowshoe hare

Table 5. Checklist of the mammals of *Noatak National Preserve,* Alaska. Current status: ● = present and substantiated with vouchered specimen, ʘ = present or probably present but not substantiated with a voucher specimen, and **?** = status unknown.

INSECTIVORA - Shrews
Family **Soricidae**
● *Sorex cinereus*, cinereus shrew
● *S. monticolus*, montane shrew
● *S. tundrensis*, tundra shrew
● *S. ugyunak*, barren ground shrew

CARNIVORA - Carnivores
Family **Canidae**
? *Alopex lagopus*, arctic fox
● *Canis lupus*, wolf
ʘ *Vulpes vulpes*, red fox

Family **Felidae**
ʘ *Lynx canadensis*, Canada lynx

Family **Mustelidae**
● *Gulo gulo*, wolverine
ʘ *Lontra canadensis*, northern river otter
● *Mustela erminea*, ermine
● *M. nivalis*, least weasel
● *M. vison*, American mink

Family **Ursidae**
? *Ursus americanus*, American black bear
● *U. arctos*, brown bear

ARTIODACTYLA - Ungulates
Family **Cervidae**
ʘ *Alces alces*, moose
● *Rangifer tarandus*, caribou

Family **Bovidae**
? *Ovibos moschatus*, muskox
● *Ovis dalli*, Dall's sheep

RODENTIA - Rodents
Family **Sciuridae**
ʘ *Marmota broweri*, Alaska marmot
● *Spermophilus parryii*, arctic ground squirrel

Family **Muridae**
● *Clethrionomys rutilus*, northern red-backed vole
● *Dicrostonyx groenlandicus*, collared lemming
● *Lemmus trimucronatus*, brown lemming
● *Microtus miurus*, singing vole
● *M. oeconomus*, tundra vole
● *M. xanthognathus*, taiga vole
● *Ondatra zibethicus*, muskrat

Family **Erethizontidae**
● *Erethizon dorsatum*, North American porcupine

LAGOMORPHA - Pikas & Hares
Family **Leporidae**
● *Lepus americanus*, snowshoe hare
? *L. othus*, Alaskan hare

Table 6. Number of small mammals and trapping effort in vegetation types (Levels I-III of Viereck et al., 1992) sampled at 14 of 17 general localities in the Western Arctic Parklands, Alaska, in July and August, 2000 and 2001.

MAMMAL SPECIES	LEVEL I	FOREST									SCRUB										HERBACEOUS							
	II	NEEDLE-LEAF			BROAD-LEAF			MIXED			DWARF TREE			TALL		LOW		DWARF			GRAM-INOID			FORB			BRY-OID	
	III	CLOSED	OPEN	WOODLAND	CLOSED	OPEN	WOODLAND	CLOSED	OPEN	WOODLAND	CLOSED	OPEN	WOODLAND	CLOSED	OPEN	CLOSED	OPEN	Dryas	Ericaceous	Willow	DRY	MESIC	WET	DRY	MESIC	WET	Mosses	Lichens
	INSECTIVORA - Shrews																											
	Sorex cinereus, cinereus shrew		3	1		1			1	9		1			1	3	9			3		2	1					
	S. monticolus, montane shrew																											
	S. tundrensis, tundra shrew		2							2		1					1					3	1					
	S. ugyunak, barren ground shrew																1					2	1					
	S. yukonicus, tiny shrew															2	1											
	RODENTIA – Rodents																											
	Clethrionomys rutilus, N. red-back. vole	13	175	4		3			43	2		6		7		4	6				13	106	4					
	Dicrostonyx groenlandicus, col. lemming															1						1						
	Lemmus trimucronatus, brown lemming								1								3					9	3					
	Microtus miurus, singing vole													5	3	25					17	47	2					
	M. oeconomus, tundra vole	1	38			10						12				15					15	60	39					
	M. xanthognathus, taiga vole		52						17					13														
	Spermophilus parryii, arctic gnd squirrel																	4			15	9		5				
	Tamiasciurus hudsonicus, red squirrel		2																									
	Erethizon dorsatum, N.A. porcupine																							1				
	TRAP NIGHTS	328	2584	100		174			756	225		611		400	390	400	1822	91		50	1235	5053	850	0				100

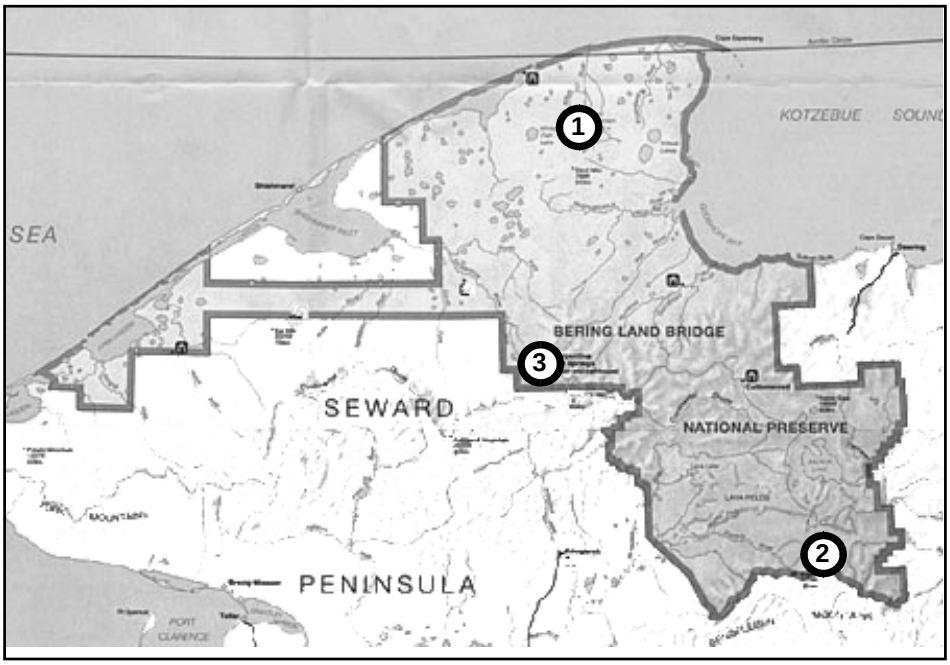


Figure 1. General localities in the *Bering Land Bridge National Preserve*, Alaska, sampled for small mammals in July and August 2001: 1) Devil Mountain Lakes, 2) Kuzitrin Lake, 3) Serpentine Hot Springs.

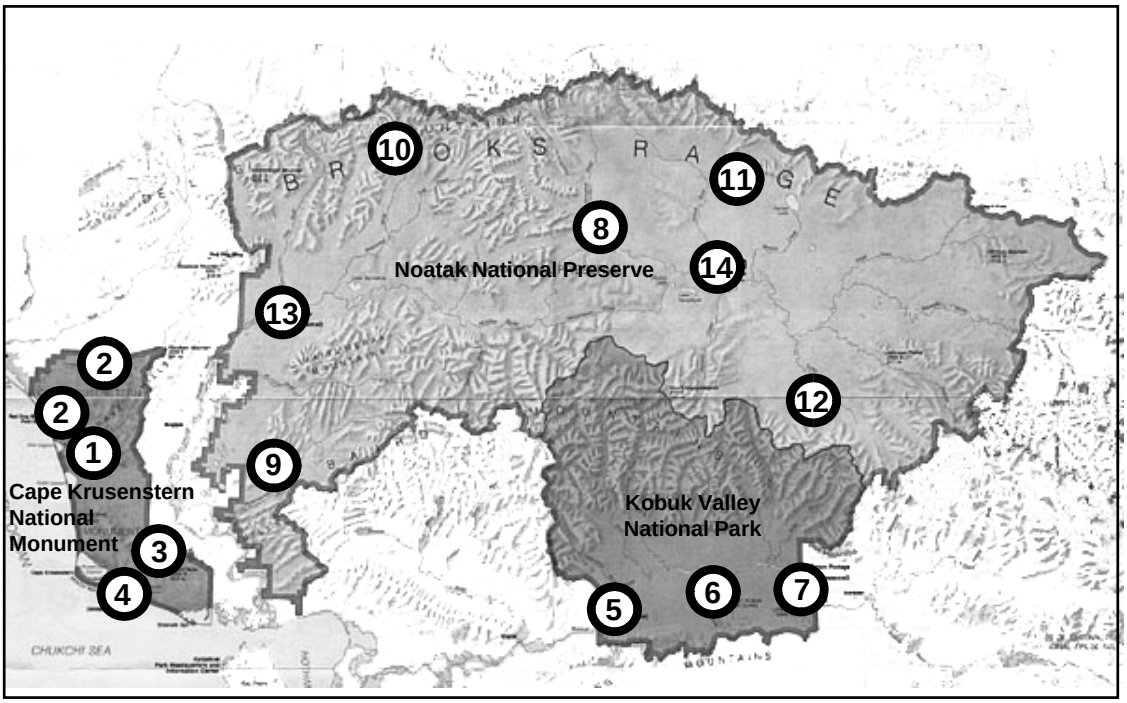


Figure 2. General localities in the *Cape Krusenstern National Monument, Kobuk Valley National Park*, and *Noatak National Preserve*, Alaska, sampled for small mammals in July and August 2001: 1) Rabbit Creek, 2) Red Dog Road, 3) Situkuyok River, 4) Tukrok River, 5) Kallarichuk River, 6) Kavet Creek, 7) Onion Portage, 8) Aniralik Lake, 9) Asik Mountain, 10) Copter Peak, 11) Desperation Lake, 12) Kaluich Creek, 13) Kelly River, and 14) Sidik Lake.

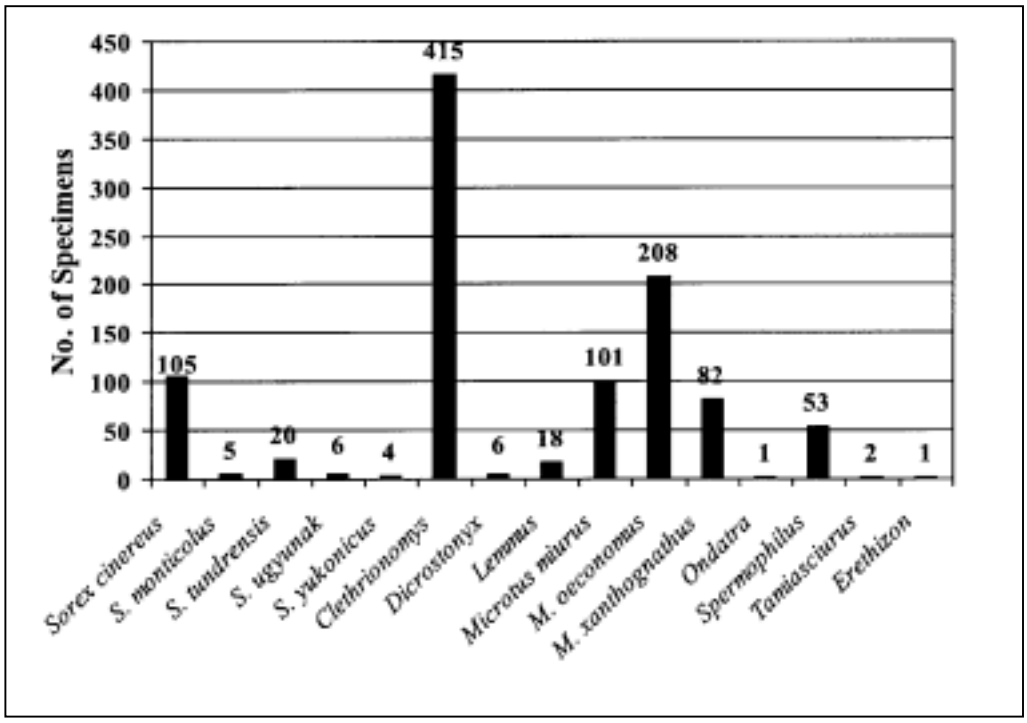


Figure 3. Total number of specimens of 15 species of small mammals sampled in the Western Arctic Parklands, Alaska, in July and August, 2000 and 2001.

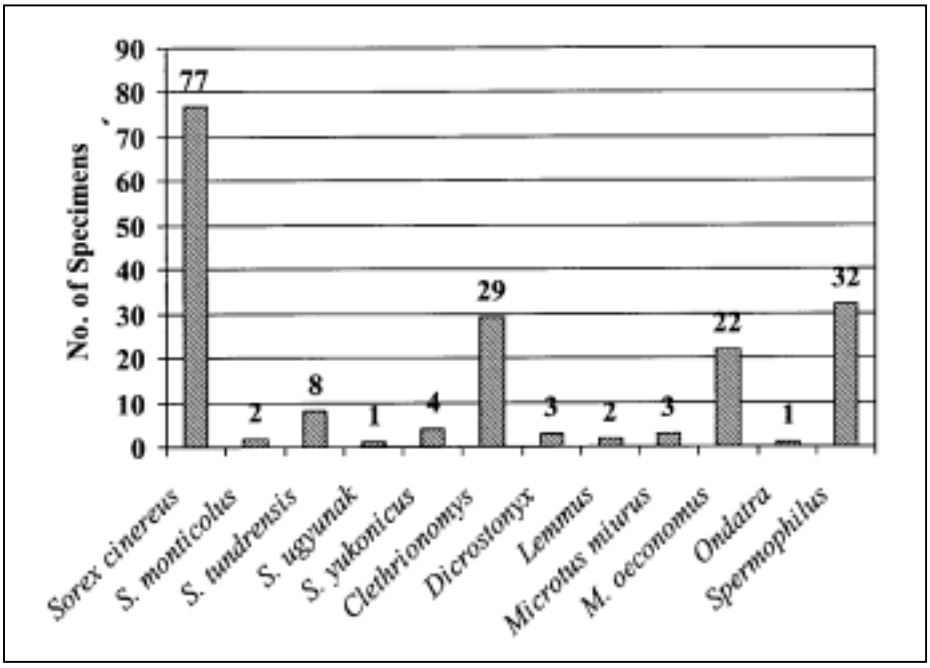


Figure 4. Total number of specimens of 12 species of small mammals sampled in the *Bering Land Bridge National Preserve*, Alaska, in July and August 2001.

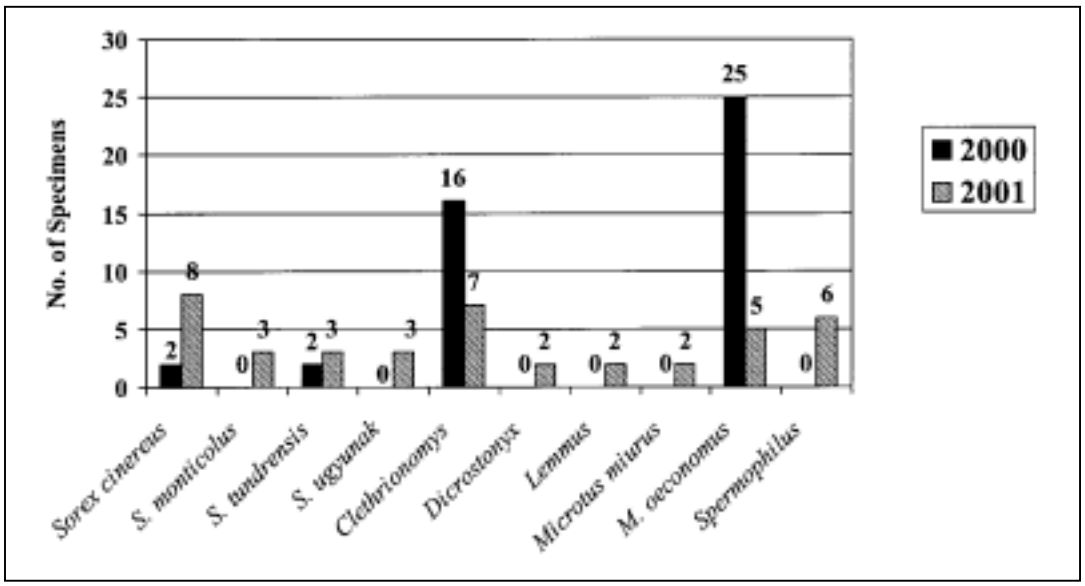


Figure 5. Total number of specimens of 10 species of small mammals sampled in the *Cape Krusenstern National Monument*, Alaska, in July and August 2000 and 2001.

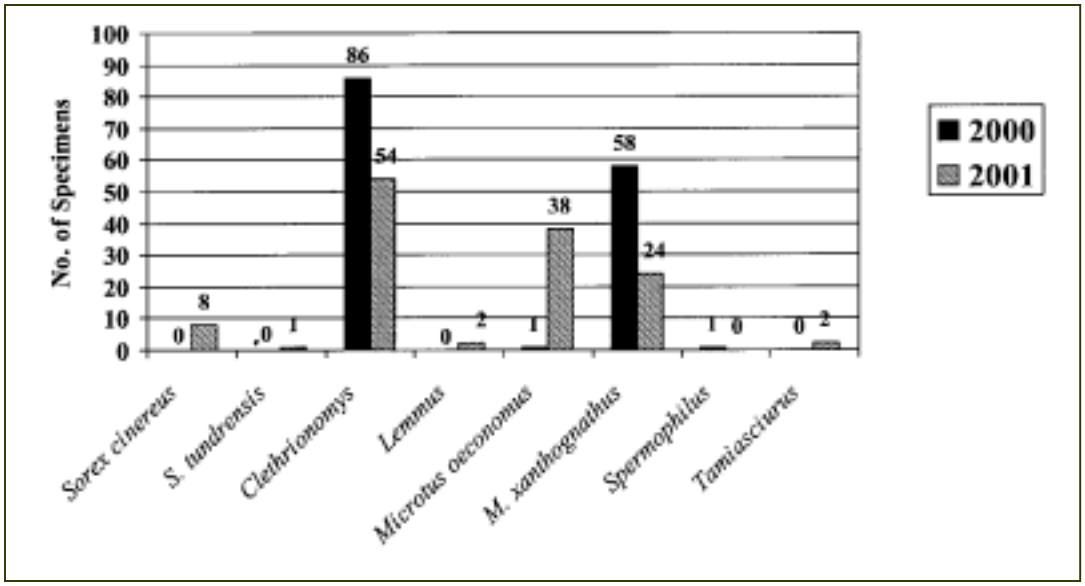


Figure 6. Total number of specimens of 8 species of small mammals sampled in the *Kobuk Valley National Park*, Alaska, in July and August 2000 and 2001.

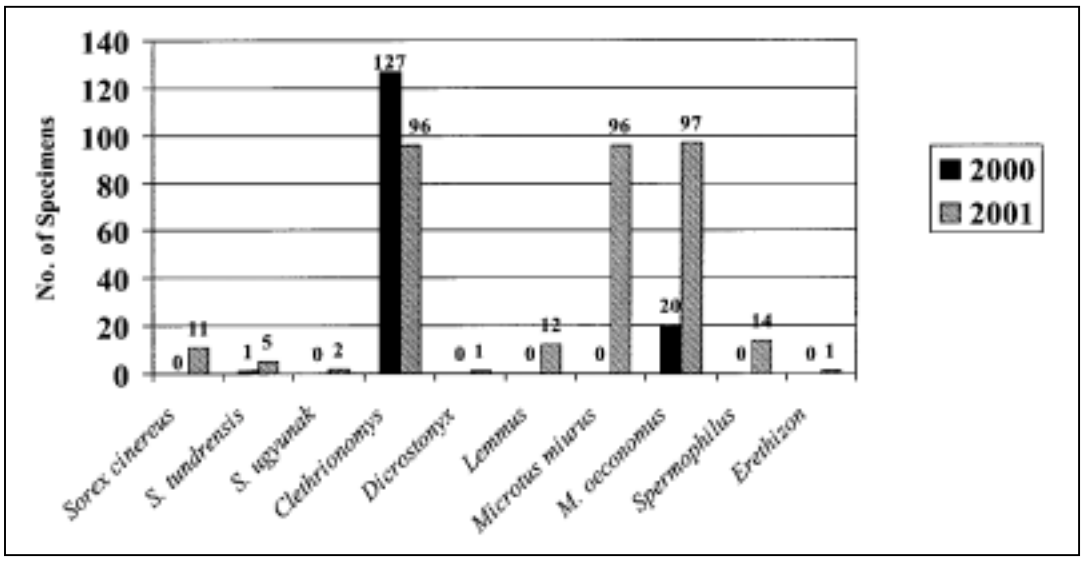


Figure 7. Total number of specimens of 7 species of small mammals sampled in the *Noatak National Preserve Alaska*, in July and August 2000 and 2001.

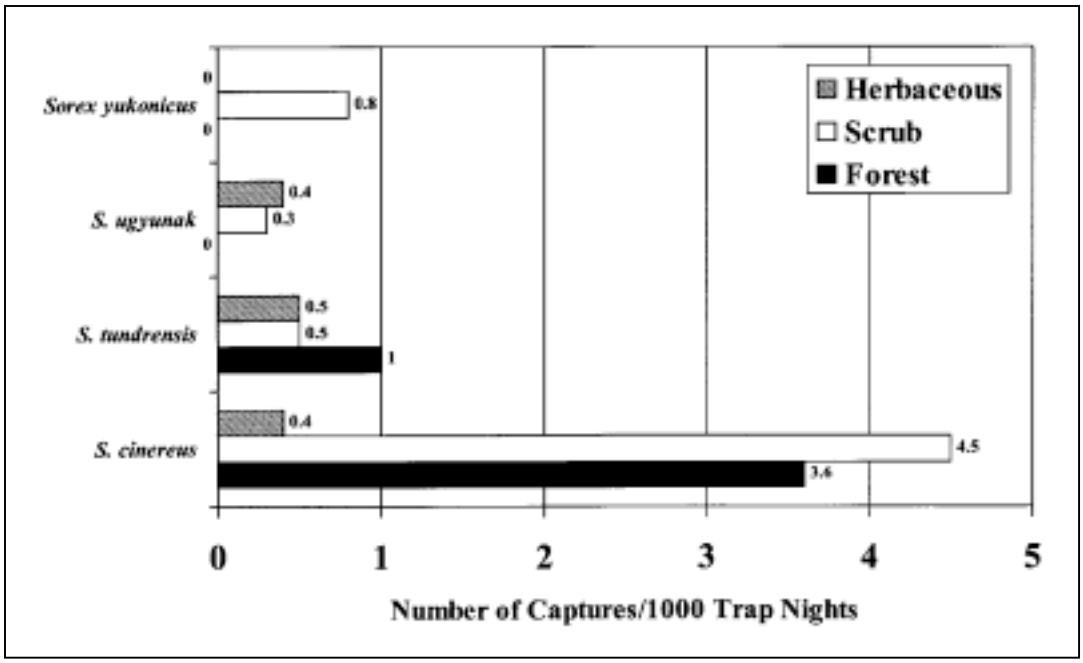


Figure 8. Relative abundance (specimens/1000 trap nights) of shrews in major vegetation types, Western Arctic Parklands, Alaska, July-August 2000 and 2001.

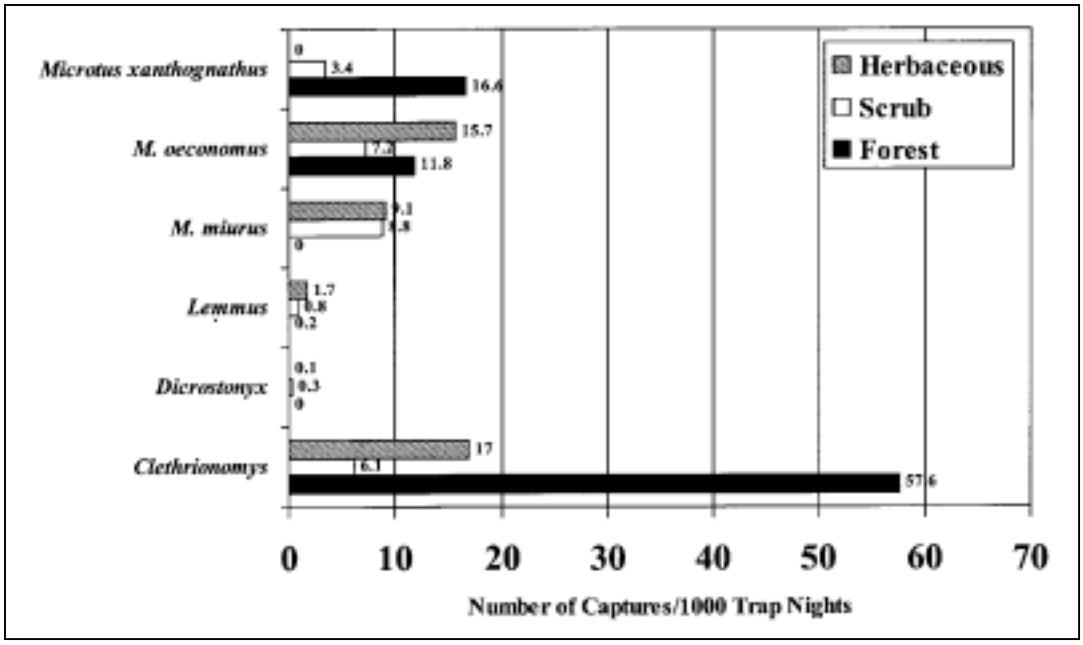
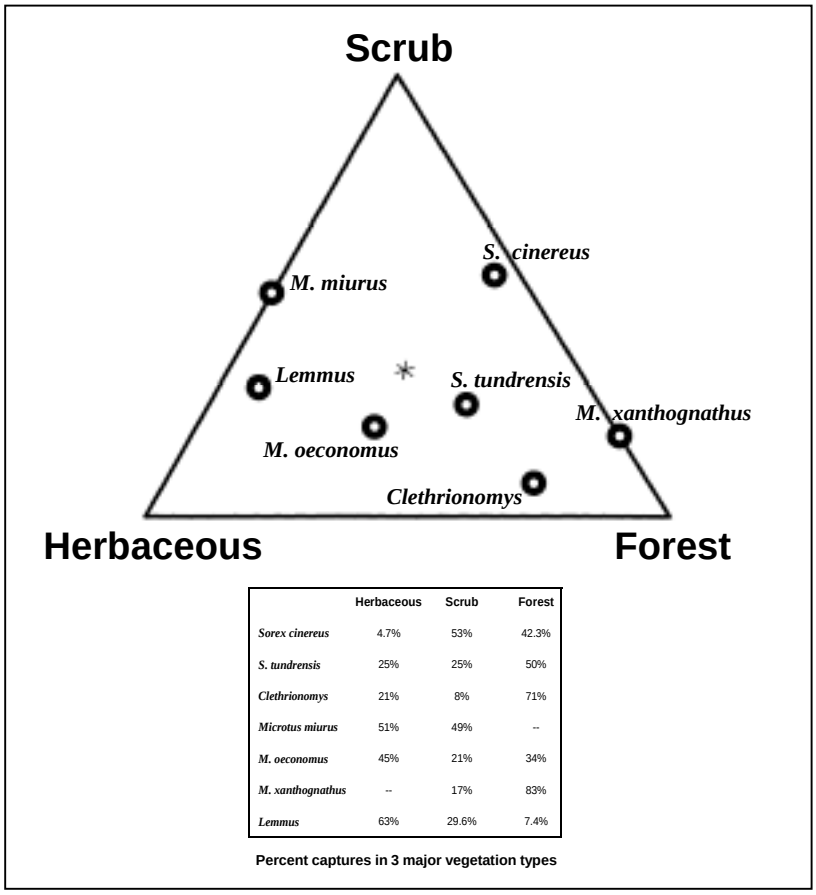


Figure 9. Relative abundance (specimens/1000 trap nights) of voles and lemmings in major vegetation types, Western Arctic Parklands, Alaska, July-August 2000 and 2001.



	Herbaceous	Scrub	Forest
Sorex cinereus	4.7%	53%	42.3%
S. tundrensis	25%	25%	50%
Clethrionomys	21%	8%	71%
Microtus miurus	51%	49%	--
M. oeconomus	45%	21%	34%
M. xanthognathus	--	17%	83%
Lemmus	63%	29.6%	7.4%

Percent captures in 3 major vegetation types

Figure 10. Proportion of small mammal specimens (relative abundances from Figure 9) in 3 major vegetation types, Western Arctic Parklands, Alaska, 2000-2001.

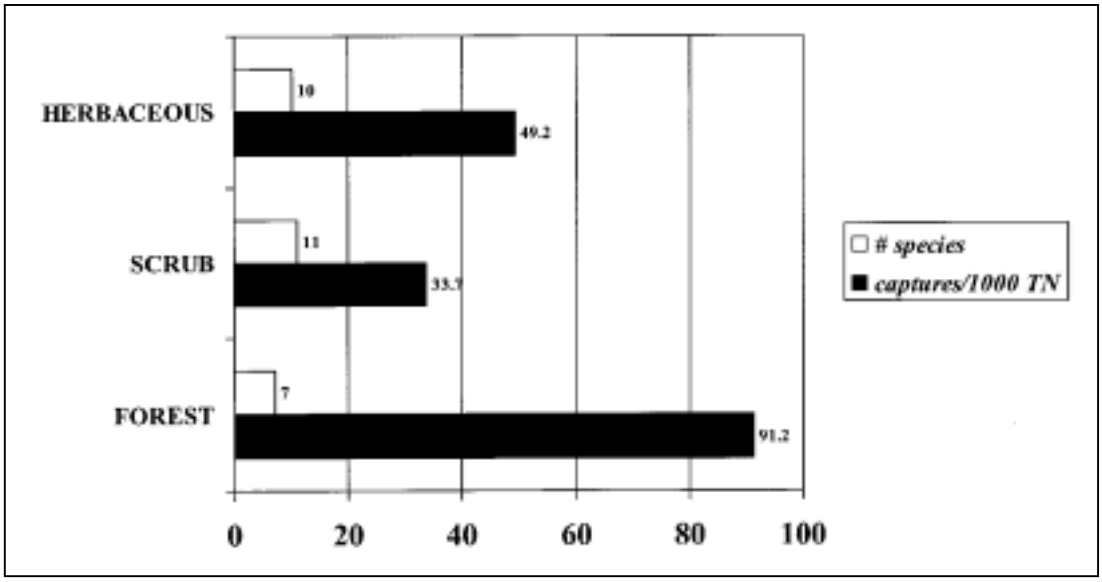


Figure 11. Species richness and relative abundance of small mammals in 3 major vegetation types, Western Arctic Parklands, Alaska, 2000-2001.

Appendix

SPECIFIC COLLECTION AND PRESERVATION PROTOCOLS

SHREWS

General: Parasites, particularly the minuscule tapeworms characteristic of shrews, decompose rapidly.

Consequently, it is necessary to make special provisions for anticipated collections of insectivores. Live traps or pitfalls should be used, and should be checked at a minimum every 3 hours. This sampling schedule is necessary as tapeworms in shrews decompose starting about 2-3 hours following death of the host. **Thus, traps must be checked frequently and any shrews collected need to be dissected immediately**. Please note in field notes how fresh the shrew was at the time of dissection.

Intestinal tracts: materials must be as fresh as possible, as decomposition of parasite specimens in shrews is exceptionally rapid and the tapeworms are very tiny and delicate. Dissect the stomach and entire small intestine from the body, leave it intact. If the specimen is fresh and/or from a mature shrew, place it in a 1.8 mL nunc tube, or appropriate size (white caplet) and freeze in LN2. If the specimen isn't fresh or as space runs out the entire intact intestine can be preserved in ^{700}/o ethanol, use a 20m1 scintillation vial. If ethanol is used it must be changed on the following day. **Immediate processing and preservation of intestinal tracts of shrews has the highest priority.**

OTHER MAMMALS

General: In water, using a petri dish of appropriate size, first uncoil the intestine, separate the small intestine, large intestine, and caecum, process separately. Record the total number (and sex ratio if possible) of each parasite type from each organ separately in the comments section of the AF sheets.

Small intestine: In water, remove the mesenteries, straighten, and open lengthwise starting in the anterior by carefully sliding blunt tipped iris scissors to cut open and expose the lumen. Alternatively, dissecting can be approached from the posterior end, allowing the dissector to encounter the posterior end of the worm first. Be careful not to cut tapeworms; remove intact tapes to a separate dish in water to relax. "Wash" (agitate) the intestine sections in the petri dish for the detached scolices and small nematodes. Record the location of the worm in the small intestine (first, second, or third part). Look carefully for any scolices if detached: this will be accomplished by using a dissecting scope or magnifying loop; pour extra water carefully away before this but do not lose the small worms.

Caecum: Nematodes or small flukes may be present in the caecum. Often trematodes (reddish--brownish in color) in the caecum of *Microtus* are covered with "mud" and are difficult to see and some nematodes are relatively small and obscure. It may be useful, therefore, to run material through a small sieve to first discard some fine particulates. *Dicrostonyx* has a nematode that is spiraled around the villi in the caecum wall.

Large Intestine: Process only if sufficient time is available; there will be little of importance here in arvicolines. Use the same techniques as with the caecum.

ALL MAMMALS

Stomach: Open in a dish of water, examine for nematodes. These are usually associated with the lining of the stomach and are on the outside of the stomach contents.

Lungs: First remove the left half of the lungs for hanta virus (see later) and freeze: be careful and use sterilized forceps only (70% ethanol and cigarette lighter). Label nunc "Hanta". Visually examine rest of lungs for nematodes. These may appear as small tan lesions on the surface and extending deeper into the lung tissue. If nematodes are present freeze ½ lung in nunc tube (white caplet) and label Lung/Nematode. One rare genus, *Angiostrongylus,* can be found in the big arteries of lungs.

Bladder- Open bladder in petri dish and examine contents under dissecting microscope.

Other Organs/Tissues- Basically parasites can occur in almost any organ- generally they are most abundant in the GI tract, but other organs including the liver (and gall bladder), etc., and the body cavity, should be examined (see Gardner protocols). Liver cysts or other Taeiid larvae loose in the coelom or thoracic cavity should be preserved in 70% ethanol.

Important- remember that all dishes, and dissectin~ instruments have to be completely clean and dry between animals. Wash and then rinse with ethanol. Tips of probes, scissors and micro-forceps can also be passed briefly through a flame after dipping in ethanol.

PARASITE HANDLING AND PRESERVATION

Cestodes (All mammalian taxa excluding shrews): Following collection from the small intestine, each specimen should be held in filtered water for an extended period (minimum 2 hours, preferably more). This allows the tapeworm to fully relax, which is necessary to examine the internal structure of the proglottids. **Following relaxation and death in water, all strobilate adult tapeworms will be preserved in** 70% **ethanol**. Preservation should be done flat for large tapes including *Andrya* and some *Hymenolepis* in rodents; this is done by leaving the cestodes in a dish of ethanol overnight, and transferring the specimen to a vial the following day. Use the appropriate size vial for the specimen so there is sufficient preservative (a ratio of about 5:1 in volume for preservative relative to the specimen is maintained). The preservative should be changed once after 24 hours. Some tapeworms in *Microtus* are quite large (up to 20 cm), so be certain to use the proper size vial- one that is large enough for the worm and a sufficient amount of ethanol. Note the location of cestode in the intestine and record in the AF book. If problems with vial size, a big tape can cut in two parts and preserved in two vials. Use one number with a and b, mark on the notes.

Digenia (Flukes): Flukes can be relaxed in filtered water, which often allows specimens to expel eggs that might otherwise obscure some organs. Preserve flukes in 70% ethanol; (or alternatively freeze in LN2 (white caplet)); if there are large numbers do both. Keep parasites from different organ systems separate.

Nematodes: Nematodes should not be held in water for extended periods of time, as osmotic pressure will eventually cause the specimen to burst. Specimens should be washed in water or saline and then preserved in 70% ethanol or frozen in LN2 (white caplet); if there are large numbers do both. Keep parasites from different organ systems separate.

Enteric Coccidians (see protocols in Gardner): Fecal samples to isolate coccidia should be taken from all species of mammals. Collect a few pellets from the rectum or a scraping from the caecum/large intestine, crush the pellets and put in potassium dichromate (2% solution). **Important:** 1) do not overfill the vial, oxygen is necessary for survival of the coccida, and 2) the specimens should not be frozen.

Blood parasites

Spleen Smears: Divide the spleen in half. Prepare a spleen smear (see Gardner); air dry and then fix with 100% methanol; store in a dry container, avoid changes in temperatures, moisture and condensation. The focus for this work is *Clethrionomys, Microtus* and *Peromyscus* and shrews; any lagomorphs; and marmots. Do a smear from snap- trapped animals. Freeze 1/2 separately in Alsever's solution and include the other half with the heart. Indicate on AF page if the spleen is enlarged.

Brain tissue, *Marmota*: Collect some brain tissue for freezing (lavender caplet).

Protocols for Ectoparasites (see protocols in Gardner): Open collection bag and place in sealed jar with chloroformed cotton balls for 5 minutes or more. Loosely stroke pelage of animal into the bag, then examine more closely for ticks, fleas, and mites. Wash collection bag with 70% ethanol, then cut corner of bag and let contents drain into a small vial. Add ecto juice to fill. Comment in the AF book the condition of the animal (as to whether or not the animal was wet vs. dry). **Do not re-use collection bags!!**

Protocols for Hanta Virus: Focus on the following rodents: *Clethrionomys, Lemmus, Dicrostonyx* and *Microtus.* Be sterile. The rodent's left lobes of lungs are frozen in a single tube; do not include with other organs; mark tube as Hanta, use no caplet (these will go with Dr. Henttonen for later screening).

Tissue-Cyst Forming Coccidia: Typically these will be found in old arvicolines. *Sarcocystis* may be present on the peritoneum and in the musculature of the hind legs as whitish thread-like structures; if observed in the peritoneum, preserve some hind-leg musculature in 70% ethanol. *Frenkelia* may be present in the brain; cysts are easily seen as whitish spots (0.5-1.0 mm) on the surface of the brain. Do not collect from specimens with intact skulls destined for the Museum. In animals with broken skulls: first remove the upper part of the skull by cutting the bone between the eyes; remove skin from the eyes backwards; cut the skull (but not the brain) starting from the eyes along the sides, and then lift the top from the anterior part exposing the brain. If present, cysts (whitish spots) will be visible; remove brain with forceps; slice into 2 or 3 parts; preserve in 70% ethanol. Remember to save the dentition from these animals.

HOW TO FILL AND LABEL CRYOTUBES

In the Alaska Frozen Tissue Collection, tissue samples are stored in 1.8 milliliter plastic cryotubes. These should be **labeled with an ultrafine Nalgene lab marker no. 6310-0010** or a **ultra fine "Sharpie" permanent marker prior to cooling.** If the tubes are not labeled before cooling, it will be necessary to rewarm the tubes in order to write on them.

The standard tissues saved on birds and mammals are heart, kidney, liver, and spleen. For small species entire organs are often stored in one tube. For larger animals, only a subsample of the organ will fit in a tube. In some cases, muscle, skin, or blood may be the only tissues collected.

Specimens should be kept clean, but are not expected to be sterile. It is especially necessary to **avoid cross contamination between individuals.** Tiny amounts of DNA from another specimen can be amplified and corrupt results. Therefore, **instruments and work surfaces should be cleaned after each individual is sampled. We use a ten percent solution of chlorine bleach** in **water to clean oft instruments. The instruments are wiped dry, then rinsed in clean water, and then wiped until dry with clean tissue paper.** Bleach destroys DNA and is an excellent disinfectant. Alcohol preserves DNA and therefore should not be used to clean instruments.

COMMON PROBLEMS

Over filling: Tubes that contain too much tissue will split when the tissue freezes and expands. Observe the fill line (approximately 2/3 full) when preparing large samples.

Loose caps: Caps may come loose and the samples may come out of the tubes. Please tighten caps firmly. This is particularly important when tubes are traveling in Dewar flasks of liquid nitrogen.

Inadequate labeling: Sloppy handwriting and faulty writing implements are major problems. **Write the AF number on the tube at least twice, and on the cap once.** Don't **try** to write on greasy, wet, or frozen tubes. Writing may be worn off of tubes if they are subjected to a lot of agitation while traveling in liquid nitrogen. This problem occurs with bags used to presample the tissues as well. Bags should be clearly labeled and if possible, a label should be included in the bag with the sample. Be sure to avoid cross contamination among bagged tissues and try to collect samples large enough so that we can obtain a cleanly trimmed final sample.

AF 46286

ALASKA FROZEN TISSUE COLLECTION
University of Alaska Museum

Collector: Nikolai Dokuchaev

Preparator: Amy M Runck Field #:

Species: Lemmus trimucronatus Sex: (M) F ?

Country/State: USA/AK Quad: Bendeleben

District (e.g. island, county, Nat'l Park): Bering Land Bridge

Specific locality: Krugitria Lake

Latitude: 65°23.363'N Longitude: 163°15.868'W Authority: GPS

Date of death: 28 July preparation:

Nature of voucher (Circle one or more): (skin skull skeleton)

fluid-preserved whole frozen tissues only other

Preserved tissue	#tubes	pres	Preserved tissue	#tubes	pres
heart			blood		
kidney + liver	1	Fz	karyotype		
heart & kidney			ectoparasites		
H, ~~K~~, lung, spleen	1	Fz	nematode		
liver			cestode		
spleen			coccidia	1	cocc
lung			other(Telford)	1	Fz
muscle			other( )		

Condition of tissues (Circle one): (poor) 1 2 3 4 (5) (excellent)

Relationship: of #

Repro condition: T=7x4

Measurements (total-tail-hindfoot-efn-weight): X

Remarks:

negative for endoparasites

Museum use: Collection Mamm UAM# Accession # 2001.040

PERMANENT ARCHIVAL RECORD - Please use permanent ink and return to University of Alaska Museum, Fairbanks, AK 99775-6960